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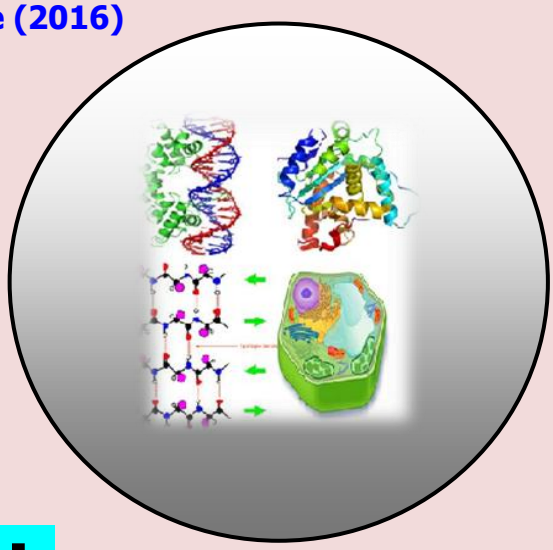

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RESEARCH PAPER

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Study Setting Artificial Irradiation on Growth and Yield of Four Varieties of *Chrysanthemum*

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ABSTRACT

Chrysanthemum plants belonging short days and facultative, characteristics this implies that the Chrysanthemum plant will be induced to enter into the generative phase and flowering when the plant received a long day shorter than Critical Day Lenght (CDL). If the length of the received Chrysanthemum on juvenile period is longer than its CDL then the Chrysanthemum plant will maintain the vegetative phase. The purpose of this study was to obtain cultivation technology with artificial illumination arrangement in accordance with the local environmental conditions in order to improve productivity and good-quality products. The study consisted of two factors arranged in a nested design where the variety is nested in artificial light settings. Varieties used include grand yellow, grand white, leneker yellow, and leneker Salem, while extra light settings used the 15-day, 30-day, and 45-day four-hour dive. The results showed that artificial light settings give real effect to the very real on all parameters observed. While the influence of varieties on any artificial light settings give real effect to the very real in all parameters were observed except on the length of the flower stalk varieties in artificial light setting 30-day/4 hours. The results of the economic weight of fresh flowers highest in light setting an additional 45 days/4 hours are 113.03 g and no significant additional light by setting a 30-day/4 hours. The results of the economic weight of fresh flowers highs due to the influence of any arrangement between varieties in artificial light 15 days/4 hours, 30 days/4 hours and 45 days/4 hours are on a grand white variety are respectively 94.50 g, 109.62 g, and 122.49 g.
Keywords: Setting Artificial Irradiation, Growth, Yield, Varieties and Chrysanthemum.

INTRODUCTION

*Chrysanthemum*s are one of the products featured floriculture developed in some centers, especially for the domestic market. The applicability of the *Chrysanthemum* on each wreath is very dominant until it reaches 30-65%. It is estimated that the supply and demand of *Chrysanthemum*s will continue to increase until 2019 with an average growth of 39.39% and 12.40% per year (Pusat Data dan Sistem Informasi Pertanian, 2014). It is prospective to grow in both qualities, quantity for industrial development efforts *Chrysanthemum*. This is an exciting opportunity for people who want to develop business *Chrysanthemum* (Direktorat Budidaya dan Pascapanen Florikultura, 2013). The cultivation of *Chrysanthemum* was originally concentrated in Java Island, has now spread to Bali. *Chrysanthemum* is a commodity that has economic value that is high enough so that the potential to be developed commercially as a basic component in agribusiness well as cut flowers, potted plants, and medicinal plants (Rukmana, 1997). The cultivation of *Chrysanthemum* was originally concentrated in Java Island, has now spread to Bali, this means that the development of ornamental plants in Bali in the future is quite good because it is supported by natural resources. This reflects that on the one hand increasing interest in ornamental plant growers and on the other hand the demand for ornamental plants also increased. This increase is due Bali as a tourism and social and cultural conditions Balinese wear flowers as a complementary

means of religious ceremonies in addition to other purposes. Production of *Chrysanthemum* flowers, especially Bali have not been able to meet the market needs for productivity is still low and growing areas are still cultivated by farmers particular, farmers who cultivate *Chrysanthemum*s in Bali were concentrated in two districts of Buleleng and Tabanan and two villages Pancasari and Kembang Merta, especially farmers *Chrysanthemum* (Bali) problems encountered include: suitability agroklimat so the impact on pests and diseases, the production process is not good cause low quality of the flowers, the provision of planting material (cuttings) from outside of Bali often do not ensure the continuity and quality so that the impact on consumer confidence, while on one hand, the World pariwiata Bali is a destination that is prospective for the development of this commodity (Arjana, Situmeang, & Suaria, 2015). According to Arjana, *et al*. (2015) that farmers may use cuttings from the parent plants and or production plants of the yellow Fijian or white Fijian varieties to address the problem of procuring high-quality seeds. Not all potential areas have been planted with ornamental plants, due to various considerations such as remoteness from the center of marketing, there is no adequate infrastructure, limited knowledge of cultivating, harvesting, and post-harvest handling. Increase production through intensification frequently encountered problems include the provision of planting material (cuttings) quality, especially farmers who are outside Java, spacing, arrangement soil moisture by mulching, the determination of the optimum dosage of organic and inorganic fertilizers, post-harvest (sorting, grading and packaging) and management of the production system. Factors such aquaculture is a cause of low production and quality of *Chrysanthemum* flowers that affect the selling price as a cut flower *Chrysanthemum* (Darti, 1992). *Chrysanthemum* plants belonging short days and facultative, characteristics this implies that the *Chrysanthemum* plant will be induced to enter into the generative phase and flowering when the plant received a long day shorter than Critical Day Lenght (CDL). If the length of the received *Chrysanthemum* on juvenile period is longer than its CDL then the *Chrysanthemum* plant will maintain the vegetative phase. With the basic characteristics of the *Chrysanthemum* plant, the standard for high maintain plant (flower stalk length) on *Chrysanthemum* cut flowers, plants maintained at the vegetative stage for a certain time in order to grow to a certain height with artificial irradiation delivery applications (Balai Penelitian Tanaman Hias, 2006). In connection with the *Chrysanthemum* plant sensibility to light, the presence of light among the dark phase is in need of attention. The existence of light among the dark phase during the induction of flowering (short day) will affect the growth of flowers, the new branch will grow with time is not the same and emerging segments of the middle or bottom of plants (over branching) (Hicklenton, 1984). Otherwise, it will affect the growth and development of interest arising from changes in the apical growth, the emergence of interest would be reducing the size and physical quality of *Chrysanthemum*s (Budiarto, 2006). Based on the above, then do research on the study of artificial illumination settings on the growth and yield of four varieties of *Chrysanthemum*.

MATERIAL AND METHODS

The study was conducted in the village of Pancasari, District Sukasada, Buleleng, in Farmers Ornamental Agro Pudak Lestari with the altitude of 1,247 meters above sea level and an average temperature of 17 ° C to 20 ° C. This study was initiated in January 2016 and ended in December 2016. The method in this research was conducted in the greenhouse with the design of a randomized two-factor pattern of nested, ie regulating artificial light made each of the three levels (15 days/4 hours, 30 days/4 hours, 45 days/4 hours), and four varieties (grand yellow, grand white, leneker yellow, leneker Salem). Each treatment was repeated 3 times, so that the necessary 36 experimental plots, plots the distance between treatment 1 m while the replay between 1.5 m, swath experiment 1 m x 1 m with a population of 64 plants. The observed parameters include plant height, leaf number, stem diameter, stem length flower, the flower stalk weight, diameter and weight of the economic interest of fresh flowers.

RESULTS AND DISCUSSION

The significance of the study of artificial illumination settings and the variety of the parameters observed on *Chrysanthemum* plants can be seen in Table I. While the influence of an artificial illumination settings and between varieties (V) on any artificial illumination settings to the average maximum plant height (cm), number of leaves maximum (pieces), stem diameter (cm), weight of the flower stalk (g), flower diameter (cm), and the economic weight of fresh flowers (g) are presented in Table 2 and 3.

Table 1. Significance of The Study Artificial (A) Illumination Setting and Variety (V) of All Parameters Observable .

Parameters	Effect between type of artificial light settings	Between varieties influence on any kind of artificial light settings		
		V in A_1	V in A_2	V in A_3
1. Plant height (cm)	**	*	*	**
2. Leaves number (strand)	**	**	**	**
3. Stem diameter (cm)	*	**	**	*
4. Flower stalk length (cm)	**	**	ns	*
5. Flower stalk weight (g)	**	*	**	**
6. Flower diameter (cm)	*	**	**	*
7. Economic weight of fresh flower (g)	**	*	*	*

**= highly significant (P<0.01); * = significantly (P<0.05); ns = not significant (P≥0.05)

The results of its statistical analysis showed that the effect of setting an artificial illumination significant effect (P <0.05) to very significant (P <0.01) in all parameters were observed. Response parameters *Chrysanthemum* against setting artificial light varies, the longer the artificial light is given an average yield higher parameter. This is demonstrated by the artificial light setting a 45-day/4 hours resulted in the average value of the highest parameters compared to artificial light settings 30 and 15 days/4 hours.

Table 2. Effect Artificial Illumination Setting and Variety of Average High Plant, Maximum Number of Leaves, Stem Diameter, and Long Flower Stalk.

Effect of arrangement between artificial illumination (A)				
Treatment	Plant height (cm)	Leaves number (strand)	Stem diameter (cm)	Flower stalk length (cm)
15 days/4 hours (A_1)	65.40 b	26.75 b	0.593 b	71.58 b
30 days /4 hours (A_2)	68.96 b	28.85 b	0.715 ab	78.60 b
45 days /4 hours (A_3)	120.06 a	35.96 a	0.836 a	130.06 a
LSD 5%	15.66	4.45	0.170	10.71
Influence between varieties (V) on any artificial light settings				
V in A_1				
Grand yellow	67.58 ab	27.00 b	0.620 b	76.58 a
Grand white	72.42 a	29.25 a	0.723 a	77.75 a
Leneker yellow	62.42 bc	25.33 c	0.507 c	66.75 b
Leneker Salem	59.17 c	25.42 c	0.523 c	65.25 b
V in A_2				
Grand yellow	71.92 ab	28.50 b	0.727 b	79.83 a
Grand white	75.75 a	33.08 a	0.837 a	81.42 a
Leneker yellow	65.67 bc	27.58 bc	0.657 c	77.00 a
Leneker salem	62.50 c	26.25 c	0.640 c	76.17 a
V in A_3				
Grand yellow	122.75 b	35.42 b	0.873 a	130.42 b
Grand white	134.50 a	38.67 a	0.910 a	138.83 a
Leneker yellow	112.82 c	35.00 b	0.793 b	127.15 b
Leneker salem	110.17 c	34.75 b	0.767 b	123.83 b
LSD 5%	7.09	1.43	0.043	6.76

Description: The average value followed by the same letter and column factor the same show no real effect on the LSD level of 5%.

The results of the economic weight of fresh flower arrangements highest in artificial light treatment 45 days/4 hours of 113.03 g and an increase of 26.52% compared with the light setting 15-day/4 hours of 83.06 g. Their response to inoculation against setting artificial irradiation 45 days/4 hours, resulting *Chrysanthemum* plants belonging short days and facultative.

Chrysanthemum critical limit of about 13.5 to 16.0 hours, *Chrysanthemum*s will grow vegetative when receiving a long day more than critical limits and be induced to enter the generative phase of a long day when it receives less than its critical limits. *Chrysanthemum*s have a nature sensitive to day length, so as to cut *Chrysanthemum* cultivation environment necessary to modify the form of additional light by using light at night to obtain the expected plant height in accordance with market demand (Sutoyo, 2011). Influence between the varieties in artificial light setting 15-day/4 hours to have a different response in each of the varieties tested. The most responsive varieties are white grand and not significant with grand yellow varieties, as well as between varieties leneker yellow and leneker Salem. Responses four varieties tested by setting artificial light 15-day/4-hour average weight economically fresh flowers highest in varieties grand white amounting to 94.50 g, while plant height maximum, stem diameter, stem length flower and heavy flower stalks influential, not evident with varieties yellow grand, grand varieties of white flower diameter significantly with grand yellow varieties. Leneker varieties of yellow and Salem showed no real influence on all parameters that were observed in Tables 1 and 2. The big difference in the response of four variations of *Chrysanthemum* varieties showed that light is one of the environmental factors that control the growth of vegetative and generative growth of *Chrysanthemum* plants (Ariesna, *et al*., 2014). This is because the amount of light received is less than the critical limit so short day plants naturally determine the change from vegetative growth to the generative development of a long period of darkness (night). Influence between the varieties in artificial light setting 30-day/4 hours showed that the grand white varieties of fresh flowers produce the heavy economical high of 109.62 g and significantly different from the grand yellow varieties, as well as the weight parameter flower stalk and flower diameter. While the yellow and Salem varieties leneker addition of artificial light settings indicate that no real influence on the observed parameters. The length of the flower stalk showed the same response on the four varieties were observed against setting artificial light 30 days/4 hours. Improved artificial light settings on four varieties of *Chrysanthemum* appeared to have a vegetative and generative growth responses are not the same on each parameter observed.

Table 3. Effect Artificial Illumination Setting and Variety of Average Weight Flower Stalk, Diameter of Interest and Economic Weight Fresh of Flowers.

Effect of arrangement between artificial illumination (A)			
Treatment	Flower stalk weight (g)	Flower diameter (cm)	Economic weight of fresh flower (g)
15 days/4 hours (A_1)	91.79 c	5.05 a	83.06 b
30 days /4 hours (A_2)	107.53 b	6.03 a	99.59 a
45 days /4 hours (A_3)	116.81 a	6.33 a	113.03 a
LSD 5%	15.68	ns	14.11
Influence between varieties (V) on any artificial light settings			
V in A_1			
Grand yellow	94.03 ab	5.33 b	80.09 b
Grand white	99.24 a	5.90 a	94.50 a
Leneker yellow	89.65 bc	4.60 c	79.79 b
Leneker Salem	84.22 c	4.37 c	77.86 b
V in A_2			
Grand yellow	105.62 b	6.37 a	99.01 b
Grand white	118.58 a	6.50 a	109.62 a
Leneker yellow	103.33 b	5.67 b	96.50 b
Leneker salem	102.57 b	5.60 b	93.22 b
V in A_3			
Grand yellow	122.30 a	6.17 b	113.22 b
Grand white	127.40 a	6.97 a	122.49 a
Leneker yellow	111.43 b	6.10 b	109.35 b
Leneker Salem	106.10 b	6.07 b	107.05 b
LSD 5%	6.60	0.43	7.86

Description: The average value followed by the same letter and column factor the same show no real effect on the LSD level of 5%.

Influence between the varieties in artificial light setting a 45-day/4 hours showed that the grand white varieties generating the highest average values for all parameters were observed, but no significant with grand yellow varieties in stem diameter and weight parameters of flowers. Salem leneker varieties produce an average value parameter lowest when compared with other varieties except with yellow leneker not significant. Grand white varieties produce heavy economical fresh flowers and a high of 122.49 g significantly different varieties of grand yellow, yellow and leneker leneker Salem. Economic weight of fresh flowers on a white grand variety increased by 12.61% when compared to varieties leneker Salem is 107.05 g. Based on the quality standard of fresh cut flowers four varieties that produce quality standard on parameters stem diameter, stem length flower, flower diameter, and heavy economical fresh flowers. *Chrysanthemum* plants require 32,000 lux of light optimal for growth of about 1.5-2 months (De Jong, 1981), with the provision of artificial light during the 45 days of the *Chrysanthemum* plant keeps growing vegetative and generative phase induced entered. To enhance the growth of *Chrysanthemum* plants require light availability between 14-16 hours/day, while for long-day flowering phase requires less than 12 hours/day.

CONCLUSIONS

Treatment between settings irradiating artificial significant effect to very significant in all parameters was observed, setting the irradiation-made 45-day/4 hours to produce stem diameter, stem length flower, heavy flower stalks, flower diameter, and economic weight of fresh flowers highest, respectively 0.836 cm, 130.06 cm, 116.81 g, and 113.03 g of 6.33 cm. The treatment effect between varieties in each setting illumination artificial 15 days, 30 day and 45 days per four hours significantly to very significant in all parameters was observed, except in the setting irradiation additional 30 days/4 long hours on the flower stalk. The results of the economic weight of fresh flowers highs due to the influence of any arrangement between varieties in artificial light 15 days/4 hours, 30 days/4 hours and 45 days 4 hours are on a grand white variety are respectively 94.50 g, 109.62 g, and 122.49 g.

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